HARVARD CENTER FOR POPULATION AND DEVELOPMENT STUDIES

Working Paper Series

Socioeconomic and gender inequalities in neonatal, postneonatal, and child mortality in India: A repeated cross-sectional study, 2005-2016

Omar Karlsson, M.Sc.,[1] Rockli Kim, Sc.D.[2], William Joe, Ph.D.,[3] and SV Subramanian, Ph.D.[2,4]

September 13, 2018

HCPDS Working Paper Volume 18, Number 1

Affiliations

1. Centre for Economic Demography, Lund University, P.O. Box 7083, 220 07 Lund, Sweden

2. Department of Social and Behavioral Sciences, Harvard T.H. Chan School of Public Health, 665 Huntington Avenue, Boston MA 02115, United States

3. Population Research Centre, Institute of Economic Growth, Delhi University North Campus, Delhi 110007, India.

4. Center for Population and Development Studies, Harvard T.H. Chan School of Public Health, 9 Bow Street, Cambridge MA 02138, United States

Abstract

Background
In India, excess female mortality, primarily concentrated in the postneonatal period, is well-documented. Deaths in early childhood are also known to be patterned by socioeconomic factors. This study examines sex differentials and sex-specific wealth gradients in neonatal (first month), postneonatal (1-12 months), and child mortality (12-60 months) in India.

Methods
Repeated cross-sectional study of nationally representative samples of 298,955 children 0-60 months old from the Indian National Family Health Surveys conducted in 2005-06 and 2015-16. The study used logistic regression models.

Findings
Overall boys had greater neonatal mortality and the difference increased over time. Girls had greater postneonatal and child mortality, overall, but the difference decreased over time. A negative wealth gradient was found for all mortality outcomes for both boys and girls. Neonatal mortality was persistently greater for boys than girls over most of the household wealth distribution. Girls had greater child mortality at low levels of wealth and greater postneonatal mortality over much of the wealth distribution. The wealth gradient in neonatal mortality decreased for girls and increased for boys. Female child mortality had a substantially stronger wealth gradient but the difference decreased over the period.

Interpretation
Not distinguishing between neonatal, postneonatal and child mortality masks important sex and socioeconomic disparities in under-5 mortality in India. Substantial gains towards the Sustainable Development Goals can be made by combatting neonatal mortality, especially at the lower levels of wealth. Although some improvements have been made, efforts to reduce excess female child and postneonatal mortality should continue.

What is already known on this subject

Previous research found a socioeconomic gradient and an excess in female under-5 mortality in India. Excess female mortality has been documented to be widespread and persistent. Excess female mortality is primarily found for child mortality after the postneonatal period while a socioeconomic gradient has been identified for under-5 mortality in all periods. A few studies have found that excess female under-5 mortality is reduced at higher levels of socioeconomic status – using measures such as caste, maternal education and household wealth. The Sustainable Development Goals call for substantial reduction in under-5 and neonatal mortality, as well as in disparities by sex and socioeconomic status in India.

What this study adds

We examined sex and wealth disparities separately for neonatal, postneonatal, and child mortality in India and explored recent developments using recently available data. Our study shows that measures of under-5 mortality mask important disparities, as neonatal mortality is greater for boys and postneonatal and child mortality is greater for girls in India. Substantial gains can be made by reducing neonatal mortality in poor household. Child mortality is greater for girls in poor households while postneonatal mortality is greater girls over much of the wealth distribution. Remaining excesses in female child and especially postneonatal mortality should be combated.

Introduction

The global under-5 mortality rate, a key indicator of child health in developing countries, decreased by 52%, from 90 deaths per 1000 live births in 1990 to 43 deaths in 2015.[1] Despite such impressive improvements, majority of low- and middle-income countries did not achieve Millennium Development Goal 4 which aimed to reduce under-5 mortality rates by two-thirds.[2] Further, in many developing countries, much of the reductions achieved were in postneonatal and child mortality, while reductions in neonatal mortality were smaller. For example, in India, the proportion of under-5 deaths occurring in the neonatal period increased from 45% in 1990 to almost 60% in 2016.[3,4] The Sustainable Development Goals (SDGs) renewed efforts and aimed to reduce under-5 mortality in every country to less than 25 deaths per 1,000 live births, and neonatal mortality to less than 12 deaths, by 2030.[5] Additionally, the SDGs called for disaggregation of essential indicators by sub-national regions, socioeconomic status, and sex to assess and combat disparities in measures of wellbeing.

India is one of the fastest growing economies in the world but, unlike for example China, still has high under-5 mortality rates.[6] With its currents rates of 43 under-5 deaths and 25 neonatal deaths per 1,000 live births,[4] India has a long way to go to reach the SDGs. Globally, India ranks 53rd (2015) regarding under-5 mortality rate; however, with over 1·3 billion population, India contributes 17% of all global under-5 deaths.[4,7] Further, substantial geographic disparities exist in the under-5 mortality rates, ranging from 12 deaths per 1,000 live births in Kerala to 73 deaths in Assam.[8] India has also been identified as a country with persistently high socioeconomic disparities in under-5 mortality.[9]

In addition to the documented socioeconomic and regional disparities, India has had substantially higher under-5 mortality for girls compared to boys. A recent study estimated an excess in female under-5 mortality rate of 18·5 per 1000 live births in 2000-2005.[10] Further, excess female mortality was found to be widespread and was identified in 90% of India's districts, with the northern states of Uttar Pradesh, Bihar, Rajasthan, and Madhya Pradesh accounting for two-thirds of the total excess in female under-5 deaths. Rapid gains in mortality reduction and equity are possible if high burden countries, such as India, show accelerated progress.

[Table 1 here]

Table 1 identifies several studies on the sex and socioeconomic differences in India's under-5 mortality. From these studies, it emerges that girls generally have a higher child and overall under-5 mortality.[9–14] There were smaller sex differences in postneonatal and infant mortality,[14] and no difference in neonatal mortality.[15] There was a significant socioeconomic gradient—measured by household wealth, caste, or parental education—in under-5 mortality across all ages (i.e., lower mortality for higher socioeconomic status).[3,13,14,16,17] Studies exploring the interaction between sex and socioeconomic status have found lower excess female mortality at higher levels of socioeconomic status.[11,15]

Greater sex disparities in child mortality than in neonatal mortality may be related to differences in the underlying mechanisms that cause mortality at different ages. The leading causes of neonatal deaths in India are preterm birth complications, neonatal infections, and birth asphyxia or trauma. [18] The leading causes of under-5 deaths that occur after the neonatal period are pneumonia or other infectious diseases and diarrhea. One study found no excess in female deaths related to birth asphyxia, sepsis, immaturity, or congenital anomalies, while deaths due to diarrhea and unexplained deaths were twice and three times as high, respectively, among girls.[19]

In this paper, we study the differences in neonatal, postneonatal, and child mortality in India by sex and household wealth, separately and jointly. Further, we explore how these relationships have evolved over the past decade using the two most recently available Indian National Family Health Survey (INFHS), conducted in 2005-06 and 2015-16. Finally, we explore regional differences in the association between sex, household wealth and mortality outcomes.

Data and Methods

Survey data

Our data came from two rounds of the INFHS, implemented by the International Institute for Population Sciences.[20,21] The 2005-06 survey was conducted between December 12, 2005, and August 27, 2006, and the 2015-16 survey was conducted between January 20, 2015, and December 2, 2016. The INFHS provides nationally representative household survey data using a multi-staged stratified sampling design. Women aged 15-49 were interviewed and information was collected regarding their birth histories and the survival status of their children. The 2015-16

(2005-06) INFHS has a response rate of 97·6% (97·7%) for households and 96·7 (94·5 %) for women.

Study population and sample

For this study, we only included children born to respondents that were residents of the household where the interview took place. We included all births that occurred 0-60 months before each survey. The archipelagos of Lakshadweep, the Andaman Islands, and the Nicobar Islands were only surveyed in 2015-16. They did, however, only make up 0·03% (0·4%) of the weighted (unweighted) sample size. The sample size in our main analysis was 298,955 births, 48,819 from the 2005-06 survey and 250,136 in the 2015-16 survey. Since the sample size from the 2005-06 INFHS was substantially smaller the confidence intervals of our 2005-06 estimates were wider.

Outcomes

We constructed three outcomes for under-5 mortality. Our first outcome was neonatal mortality, which we approximated using an indicator for death during the first month of life. The second outcome was postneonatal mortality, which we approximated using an indicator for death between 1 and 12 months of age. For postneonatal mortality, we excluded children that died in the neonatal period or were less than one month old at the time of the survey (n=10,823) since they had not entered the risk period. The third outcome was child mortality, which indicates whether a child died between the ages of 13 and 60 months. For child mortality, we excluded children that died at less than 13 months of age or were less than 13 months old at the time of the survey (n=70,481). Due to some heaping of mortality at the ages of 12 and 60 months, mortality at 12 months old was classified as postneonatal mortality, and mortality at 60 months old was classified as child mortality. For example, 3·8% of unweighted deaths occurred at 12 months of age compared to 0·62% at 11 months and 0·25% at 13 months.

Predictors

We used the household wealth index provided in the INFHS as our measures of socioeconomic status. A wealth factor score was obtained by conducting a principal component analysis using data on household asset ownership and the quality of living quarters (See Table S1 for list of

items)[22]. From these factor scores, we calculated a wealth index percentile (WIP) by dividing the factor scores into 100 groups of roughly equal size for each survey. When calculating the percentiles, we applied the INFHS provided household weights.

Analysis

We then estimated logit models separately for boys and girls, and by the 2005-06 and the 2015-16 surveys.

Eq1.

$$logit\big(P(Y=1)\big) = \alpha + \beta_1\, WIP + \beta_2\, WIP^2 + \rho\, rural + \gamma\, respondents\ age + \ln(months\ since\ birth + 1) + \varepsilon$$

The WIP was our primary exposure variable of interest, and since the impact of wealth is likely to be nonlinear, we included a squared term, to allow for the diminishing marginal impact on mortality at higher levels of wealth. In order to adjust for wealth and mortality differences between urban and rural areas, we controlled for the variable of living in a rural area. In order to improve fit and reduce standard errors, we also controlled for the wide age range of respondents at the time of interviews and number of months since the child was born. We adjusted the estimates from Eq1 using the sampling weights provided for respondents in the INFHS and adjusted standard errors for clustering at the level of primary sampling units (PSU). Note that in practice, a fully interacted model, with regards to sex and survey, was estimated (with sampling weights adjusted to add up to one for each survey). It gave identical parameters to Eq1 but made post-estimation of the parameters, i.e. differences by sex and survey (Tables S2 and S3) and male to female ratio of predicted mortality (Figures 1 – 3 panels c), more straightforward.

We graphically present the predicted probabilities of mortality at each WIP, for each sex and survey (Figures 1 – 3 panels a and b). We also calculated the male to female ratio of mortality at each WIP for each survey (Figures 1 – 3 panels c). We obtained the ratio by dividing the predicted probabilities of mortality for boys by the predicted probabilities for girls at each WIP (blue line divided by the red line). Hence a ratio greater 1 indicates greater male mortality and a ratio less than 1 indicates greater female mortality. In addition, we also summarize our findings

numerically in Tables S2 and S3. First, we present the average probabilities of mortality across the WIP distribution, and the sex and survey differences in average probabilities (Table S2). We then provide estimates of the average marginal effect (AME) of the WIP on the probability of mortality, and the sex and survey differences in the AME (Table S3). The AME indicates the average (across the distribution of the WIP) change in mortality associated with a unit increase in the WIP. Finally, we present the results for six sub-regions (Tables S4 and S5).

Conflict of interest

The authors declare that they have no conflict of interest.

Ethical clearance

This analysis was reviewed by the Harvard T.H. Chan School of Public Health Institutional Review Board and was considered exempt from full review because the study was based on an anonymous public use data set with no identifiable information on the survey participants.

Results

Descriptive statistics are shown in Table 2. Between the 2005-06 and the 2015-16 surveys, neonatal mortality decreased from a mean of 0·038 to 0·029, postneonatal mortality from 0·019 to 0·013, and child mortality from 0·009 to 0·004. Although households were divided by wealth into 100 roughly equal categories, the children were, on average, born into a household in the 44th WIP, in both surveys.

[Table 2 here]

Figure 1 shows our results for neonatal mortality and indicates a clear, and mostly linear, WIP gradient in predicted neonatal mortality for boys and girls in both survey periods. In 2005-06, the confidence intervals were largely overlapping between predicted probability of neonatal mortality for girls and boys, whereas in 2015-16 boys had a significantly higher probability of dying in the neonatal period across most of the WIP distribution. The average sex difference was small in 2005-06 (0·004; 95% confidence interval [CI], -0·001, 0·008), but increased to 0·007 (95% CI, 0·005, 0·008) in 2015-16 (see Table S2). The change in average sex difference (-0·003; 95% CI, -0·008, -0·002) was, however, not statistically significant. The average WIP gradient for neonatal mortality was similar for boys and girls in 2005-06, with a non-significant difference of 0·0006

(95% CI, -0·0013, 0·0026) (see Table S3). In 2015-16, the AME increased for boys but decreased for girls and the sex difference in AME of WIP for neonatal mortality increased to -0·0014 (95% CI, -0·0022, -0·0006). Panel (c) shows that in 2005-06, the ratio of predicted neonatal mortality at very low WIP was close to one, but the proportion of male neonatal deaths increased sharply with increasing WIP, until it flattened out around WIP 50, where boys accounted for about 25% more neonatal deaths than girls. This pattern changed in 2015-16, where boys accounted for a bigger share of neonatal deaths across the entire WIP distribution. At the bottom of the WIP distribution, boys accounted for nearly 50% more neonatal deaths than girls. The ratio decreased with increasing WIP and flattened around WIP 50 where boys had over 25% higher probability of neonatal deaths.

[Figure 1 here]

Figure 2 shows our results for postneonatal mortality. There was a clear, but nonlinear, WIP gradient, which was steeper in 2005-06 than in 2015-16, especially for girls. In 2005-06, girls had higher levels of postneonatal mortality than boys but the confidence intervals for boys and girls overlapped before WIP 20 and after WIP 60. In 2015-16, girls still had higher predicted postneonatal mortality across most of the WIP distribution, although the confidence intervals largely overlapped. Girls had a higher average probability of dying in the postneonatal period in both survey years (see Table S1). The sex differential did, however, decrease substantially from -0·006 (95% CI, -0·009, -0·003) in 2005-06 to -0·002 (95% CI, -0·003, -0·001) in 2015-16. The average WIP gradient was weaker for postneonatal mortality than for neonatal mortality (see Table S3). There were no statistically significant differences in the AME of WIP between boys and girls and between the surveys. In Panel (c) the male/female ratio in postneonatal mortality, in 2005-06, shows a higher probability of mortality for girls until WIP 70. The sex difference was greatest around WIP 40, where girls had an approximately 30% higher probability of dying in the postneonatal period than boys. The pattern looked similar in 2015-16, although the sex difference was not as big. The 2015-16 confidence intervals did, however, overlap with those of 2005-06.

[Figure 2 here]

Figure 3 shows our results for child mortality. In 2005-06, there was a clear WIP gradient, especially for girls, who also had higher probability of child mortality. At the bottom of the WIP

distribution, girls had 0·03 probability of dying in childhood while boys had a probability of 0·01. The probability declined sharply for girls with increasing WIP but remained greater than that of boys until above WIP 70, where the probability of mortality was very low overall. In 2005-06, the confidence intervals for boys and girls overlapped after WIP 30. In 2015-16, the probability of dying in childhood decreased considerably, especially for girls from poorer households. Girls still had a higher probability of mortality at the lowest levels of WIP, although the confidence intervals mostly overlap. Overall, child mortality was higher for girls in 2005-06, when the average difference was -0·006 (95% CI, -0·008, -0·003) (see Table S2). In 2015-16, the average sex difference in child mortality decreased to less than -0·001 (95% CI, -0·001, 0·000). In 2005-06, the average WIP gradient was stronger for girls, who had an average change in the probability of neonatal mortality of -0·0028 (95% CI, -0·0042, -0·0015) for a 10-percentile increase in WIP (see Table S3). For boys, the AME was -0·0008 (95% CI, -0·0015, -0·0001), and thus there was a sex difference of 0·002 (95% CI, 0·0006, 0·0035). In 2015-2016, the average WIP gradient was weaker for both boys and girls than in 2005-06; and the sex difference in the AME was smaller, 0·0005 (CI 95%, 0·0001, 0·0009). The male/female ratio in Panel (c) shows proportionally greater female child mortality at very low levels of WIP in both surveys. Girls had a probability of child mortality that was over 50% higher than boys at the bottom of the WIP distribution. The difference decreased in 2015-16, although the confidence intervals overlapped.

[Figure 3 here]

Supplementary Tables S3 and S4 show results for six Indian sub-regions. Most regions also had a greater decrease in neonatal mortality for girls than for boys over the decade. All sub-regions, except northeast India, showed a higher postneonatal mortality for girls in 2005-06. In 2015-16, central, east and north India still had greater postneonatal mortality for girls, although the difference had decreased in all sub-regions except central India. The sex difference in postneonatal mortality was, however, only statistically significant in north and east India in 2005-06, and only in north India in 2015-16. Girls had higher child mortality in most regions in 2005-06, but the sex difference was only statistically significant in north India. In 2015-16, the sex differences in child mortality were mostly gone in all regions except north India where females had higher mortality. South India had a large increase in average wealth gradient in neonatal

mortality for boys, and northeast India had a large increased average wealth gradient in postneonatal mortality for girls.

Discussion

By assessing the differences in neonatal, postneonatal, and child mortality by sex and household wealth, separately and both jointly, over time, we found that boys had higher neonatal mortality than girls both in 2005-06 and 2015-16. Girls had greater postneonatal and child mortality, but the sex difference decreased between 2005-06 and 2015-16, especially for child mortality. In fact, in 2015-16, there was no statistically significant difference between male and female child mortality in India.

Across all outcomes, we identified a socioeconomic gradient whereby the probability of mortality decreased with increasing household wealth. We find a stronger wealth gradient in neonatal mortality for boys while the wealth gradient in child mortality is stronger for girls. Measuring through a sex ratio, we found greater male neonatal mortality at all levels of household wealth. We found greater female postneonatal mortality over most of the wealth distribution, except in the poorest and richest households. Female child mortality was only greater in the poorest households.

This study confirms that neonatal deaths represent the biggest share of under-5 deaths in India.[3] Our study further confirms the presence of greater female postneonatal and child mortality, [3,12,14,19] and not in neonatal mortality.[15] Conversely, we found greater neonatal mortality among boys. We find that excess female postneonatal and child mortality remain especially large in north India, which corroborates finding from a recent study.[10] We also identified a socioeconomic gradient—measured by household wealth—for all mortality outcomes, which is in line with the results of previous research.[14,16,17]

Globally, India and China have the most significant deficits in the proportion of women that would be expected in their populations (i.e., "missing women"), and research has suggested that the resulting surplus of men leads to social problems, such as increased crime in general, and against women in particular.[23,24] India's excess female under-5 mortality has often been attributed to a preference for sons rooted in cultural and institutional traditions.[25,26] Parents may feel that sons will provide them with security in their old age, or they may believe that sons have higher

earning potential, be able to sustain the family lineage, and do not have the dowry costs associated with girls. Studies have suggested that economic development by itself is not enough to break down the tenacity of norms favoring sons but that female education and access to "modern" information through media reduces son preference.[27–29]

A limitation of the study was the use of mortality estimates for children that had not lived through the risk period, so mortality levels are likely to be underestimated. However, the main interest of this study was not to estimate levels of mortality but differences by sex, socioeconomic status, and over time. We further only estimate sex differences in mortality while sex selective abortion is an increasingly prominent concern, contributing to skewed sex ratios. However, excess in female mortality remains the most prominent cause of skewed sex ratios.[26] Finally, the excess female mortality may be greater than indicated by sex differences in mortality outcomes since boys generally have higher mortality in a low-income setting due to biological frailty.[30–32] Therefore our estimates of sex difference in postneonatal and child mortality are likely to underestimate the excess in female mortality.

Our study is the first to explore recent developments in the sex and wealth inequalities present in India's neonatal, postneonatal and child mortality. Overall under-5 mortality conceals the extent of disparities as boys have higher neonatal mortality while girls have greater postneonatal and child mortality. Some gains have been made in reducing the female disadvantage in child mortality although disparities remain in poor households. Postneonatal mortality remains greater for females at most levels of wealth. Our findings suggest that significant gains can be made in reducing under-5 deaths by combatting neonatal deaths. Specifically, actions must be taken to prevent pre-term birth complications, neonatal infections, and birth asphyxia and trauma.[18,19] Our findings further underline the need to address the high levels of wealth inequality, especially in neonatal mortality which have increased in most sub-regions and especially for boys. Although some progress may have been made towards reducing excess female postneonatal and child mortality in India, efforts need to continue, especially in north India.

References

1 UN U. The millennium development goals report. UN New York, 2015.

2 You D, Hug L, Ejdemyr S, *et al.* Global, regional, and national levels and trends in under-5 mortality between 1990 and 2015, with scenario-based projections to 2030: a systematic analysis by the UN Inter-agency Group for Child Mortality Estimation. *The Lancet* 2015; **386**: 2275–2286.

3 Sankar MJ, Neogi SB, Sharma J, *et al.* State of newborn health in India. *Journal of Perinatology* 2016; **36**: S3.

4 WHO. Global health observatory data repository. 2018. http://apps.who.int/gho/data/view.main.182?lang=en.

5 United Nations. Transforming our world: the 2030 Agenda for Sustainable Development: Sustainable Development Knowledge Platform. 2018. https://sustainabledevelopment.un.org/post2015/transformingourworld (accessed May 15, 2018).

6 World Bank. World Development Indicators| World DataBank. 2017. http://databank.worldbank.org/data/reports.aspx?source=world-development-indicators.

7 Liu L, Oza S, Hogan D, *et al.* Global, regional, and national causes of under-5 mortality in 2000–15: an updated systematic analysis with implications for the Sustainable Development Goals. *The Lancet* 2017; **388**: 3027–3035.

8 Munshi V, Yamey G, Verguet S. Trends In State-Level Child Mortality, Maternal Mortality, And Fertility Rates In India. *Health Affairs* 2016; **35**: 1759–1763.

9 Chao F, You D, Pedersen J, Hug L, Alkema L. National and regional under-5 mortality rate by economic status for low-income and middle-income countries: a systematic assessment. *The Lancet Global Health* 2018; **6**: e535–e547.

10 Guilmoto CZ, Saikia N, Tamrakar V, Bora JK. Excess under-5 female mortality across India: a spatial analysis using 2011 census data. *The Lancet Global Health* 2018; **6**: e650–e658.

11 Murthi M, Guio A-C, Dreze J. Mortality, fertility, and gender bias in India: A district-level analysis. *Population and development review* 1995; : 745–782.

12 Ram U, Jha P, Ram F, *et al.* Neonatal, 1–59 month, and under-5 mortality in 597 Indian districts, 2001 to 2012: estimates from national demographic and mortality surveys. *The Lancet Global Health* 2013; **1**: e219–e226.

13 Singh-Manoux A, Dugravot A, Smith GD, Subramanyam M, Subramanian SV. Adult education and child mortality in India: the influence of caste, household wealth, and urbanization. *Epidemiology (Cambridge, Mass)* 2008; **19**: 294.

14 Subramanian S v., Nandy S, Irving M, Gordon D, Lambert H, Davey Smith G. The Mortality Divide in India: The Differential Contributions of Gender, Caste, and Standard of Living Across the Life Course. *Am J Public Health* 2006; **96**: 818–25.

15 Chowdhury R, Taneja S, Mazumder S, Bhandari N, Strand TA. Gender differences in infant survival: a secondary data analysis in rural North India. *BMJ Open* 2017; **7**. DOI:10.1136/bmjopen-2016-014179.

16 Ghosh R. Child mortality in India: a complex situation. *World J Pediatr* 2012; **8**: 11–8.

17 Jain N, Singh A, Pathak P. Infant and child mortality in India: trends in inequalities across economic groups. *Journal of Population Research* 2013; **30**: 347–365.

18 Million Death Study Collaborators. Causes of neonatal and child mortality in India: a nationally representative mortality survey. *The Lancet* 2010; **376**: 1853–1860.

19 Khanna R, Kumar A, Vaghela JF, Sreenivas V, Puliyel JM. Community based retrospective study of sex in infant mortality in India. *Bmj* 2003; **327**: 126.

20 International Institute for Population. India National Family Health Survey (NFHS-3), 2005-06. International Institute for Population Sciences, 2007.

21 International Institute for Population. India National Family Health Survey (NFHS-3), 2015-16. International Institute for Population Sciences, 2018.

22 DHS. The DHS Program - Wealth Index Construction. 2018. https://www.dhsprogram.com/topics/wealth-index/Wealth-Index-Construction.cfm (accessed Aug 4, 2018).

23 Edlund L, Li H, Yi J, Zhang J. Sex ratios and crime: evidence from China's one-child policy. IZA Discussion Papers, 2007.

24 Hesketh T, Xing ZW. Abnormal sex ratios in human populations: causes and consequences. *Proceedings of the National Academy of Sciences* 2006; **103**: 13271–13275.

25 Croll E. Endangered daughters: Discrimination and development in Asia. Psychology Press, 2000.

26 Bongaarts J, Guilmoto CZ. How many more missing women? Excess female mortality and prenatal sex selection, 1970–2050. *Population and Development Review* 2015; **41**: 241–269.

27 Pande R, Malhotra A, Mathur S, *et al.* Son preference and daughter neglect in India. 2006.

28 Gaudin S. Son preference in Indian families: Absolute versus relative wealth effects. *Demography* 2011; **48**: 343–370.

29 Pande RP, Astone NM. Explaining son preference in rural India: the independent role of structural versus individual factors. *Population Research and Policy Review* 2007; **26**: 1–29.

30 Rutstein SO. Effects of preceding birth intervals on neonatal, infant and under-five years mortality and nutritional status in developing countries: evidence from the demographic and health surveys. *International Journal of Gynecology & Obstetrics* 2005; **89**: S7–S24.

31 Sawyer CC. Child mortality estimation: estimating sex differences in childhood mortality since the 1970s. *PLoS Medicine* 2012; **9**: e1001287.

32 Costa JC, da Silva ICM, Victora CG. Gender bias in under-five mortality in low/middle-income countries. *BMJ global health* 2017; **2**: e000350.

Table 1. Studies on differentials in early-life mortality by socioeconomic status and sex in India

Study	Outcome	SES disparities	Sex disparities	Interaction between sex and SES
Sankar et al·, 2016	NMR, IMR, ENMR	Caste, parental education, father's occupation gradient	Higher IMR for Females	
Chowdhury, Taneja, Mazumder, Bhandari, & Strand, 2017	NMR, ENMR, PMR		Higher PMR for females. No difference in NMR. Males higher ENMR	Lower excess PMR for females at higher levels of wealth
Subramanian et al·, 2006	Mortality across age groups (e.g. infant- and 2-5 years old)	Standards of living gradient	Higher mortality for females 2 - 5 years old. Small differences for IMR	
Singh-Manoux, Dugravot, Smith, Subramanyam, & Subramanian, 2008	U5MR	Gradient by education of household members		
Murthi, Guio, & Dreze, 1995	U5MR		Female disadvantage	Female literacy and occupation lowers the excess female mortality.
Khanna, 2003	IMR		Higher IMR for girls	
Ghosh, 2012	NMR, PMR, CMR	A wealth gradient for all mortality outcomes		
Guilmoto, Saikia, Tamrakar, & Bora, 2018	U5MR		Higher U5MR for girls	
Ram et al·, 2013	U5MR, NMR, 1 - 59 months old		Higher mortality for females at 1-59 months old. Not reported for NMR	
Chao, You, Pedersen, Hug, & Alkema, 2018	U5MR			
Jain, Singh, & Pathak, 2013	IMR, CMR	Persistent wealth inequality in IMR and CMR		

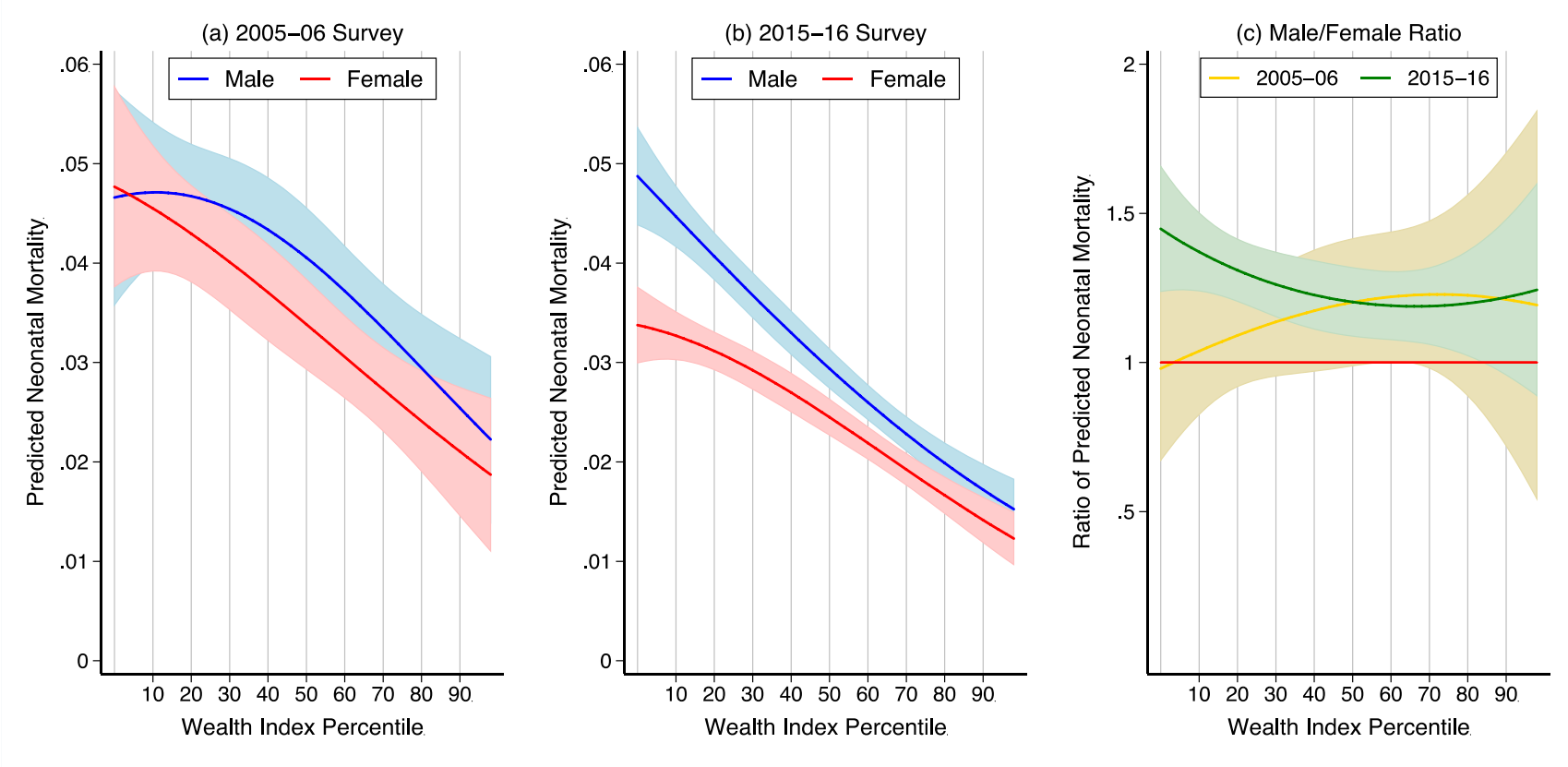
Notes: Infant mortality rate (IMR), neonatal mortality rate (NMR), early neonatal mortality rate (ENMR), postneonatal mortality rate (PMR), under-5 mortality rate (U5MR), child mortality rate (CMR), socioeconomic status (SES).

Table 2· Descriptive statistics

	2005-06			2015-16		
	Mean	**SD**	**95% CI**	**Mean**	**SD**	**95% CI**
Neonatal Mortality	0·038	0·191	[0·036, 0·040]	0·029	0·168	[0·028, 0·030]
Postneonatal Mortality	0·019	0·137	[0·017, 0·021]	0·013	0·112	[0·012, 0·013]
Child Mortality	0·009	0·097	[0·008, 0·011]	0·004	0·059	[0·003, 0·004]
Female	0·479	0·5	[0·473, 0·485]	0·478	0·499	[0·475, 0·480]
Months Since Birth	30·943	17·387	[30·778, 31·108]	30·741	17·327	[30·651, 30·832]
Rural	0·744	0·437	[0·724, 0·764]	0·717	0·45	[0·709, 0·726]
Maternal age	26·523	5·447	[26·420, 26·626]	26·957	5·005	[26·915, 26·999]
Wealth index percentile	43·917	28·119	[42·892, 44·941]	44·091	28·336	[43·664, 44·518]
Central India	0·09	0·287	[0·077, 0·104]	0·093	0·291	[0·089, 0·097]
East India	0·249	0·432	[0·225, 0·274]	0·257	0·437	[0·249, 0·266]
North India	0·275	0·447	[0·252, 0·298]	0·25	0·433	[0·242, 0·257]
Northeast India	0·04	0·197	[0·033, 0·047]	0·037	0·189	[0·035, 0·039]
South India	0·156	0·363	[0·141, 0·171]	0·179	0·383	[0·172, 0·186]
Western India	0·189	0·392	[0·170, 0·209]	0·184	0·387	[0·176, 0·191]
Observations	48,819			250,136		

Notes: All estimates are weighted using probability weights for respondents and adjusted for clustering at the PSU level. The wealth index percentiles are calculated using probability weights for households· Postneonatal mortality excludes neonatal deaths and children less than 1 month old at the time of survey. Child mortality excludes posneonatal- and neonatal deaths and children that less than13 months at the time of survey. Descriptive statistics are for full sample of children born 0 - 60 months before a survey.

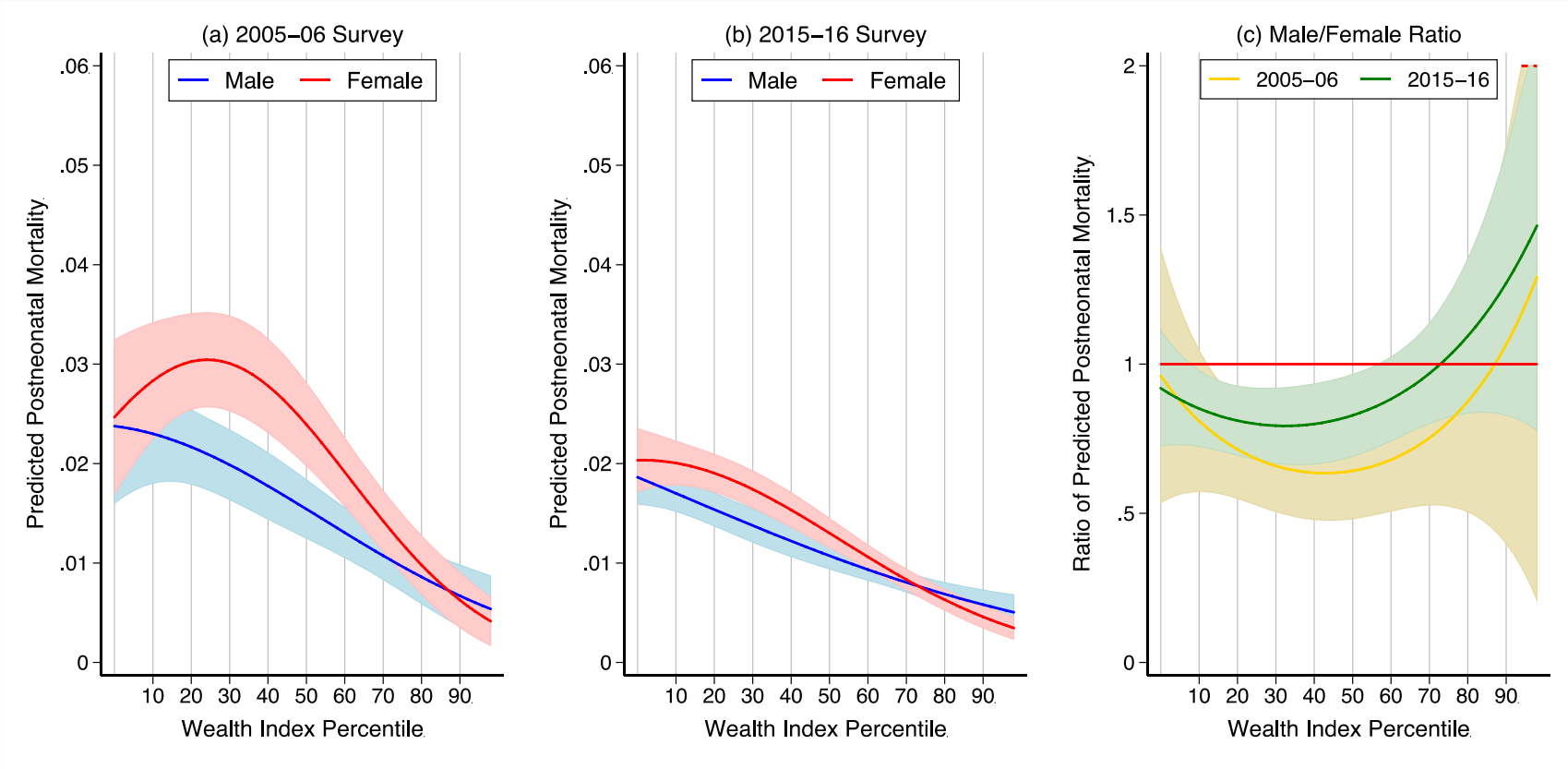
Figure 1. Predicted neonatal mortality by sex and survey



Notes: Predicted probabilities from EQ1. The ratio is for predicted outcomes between males and females (the blue line divided by the red line). A ratio of one indicates equal predicted mortality. Ratio above one means proportionally greater mortality for males. A ratio below one means a proportionally greater mortality for females. Ratios under 0 and above 2 are omitted from the graph. Estimates are weighted and confidence intervals adjusted for clustering at the PSU level. See Table S2 for average predicted probabilities and Table S3 for average marginal effects of WIP, by sex and survey.

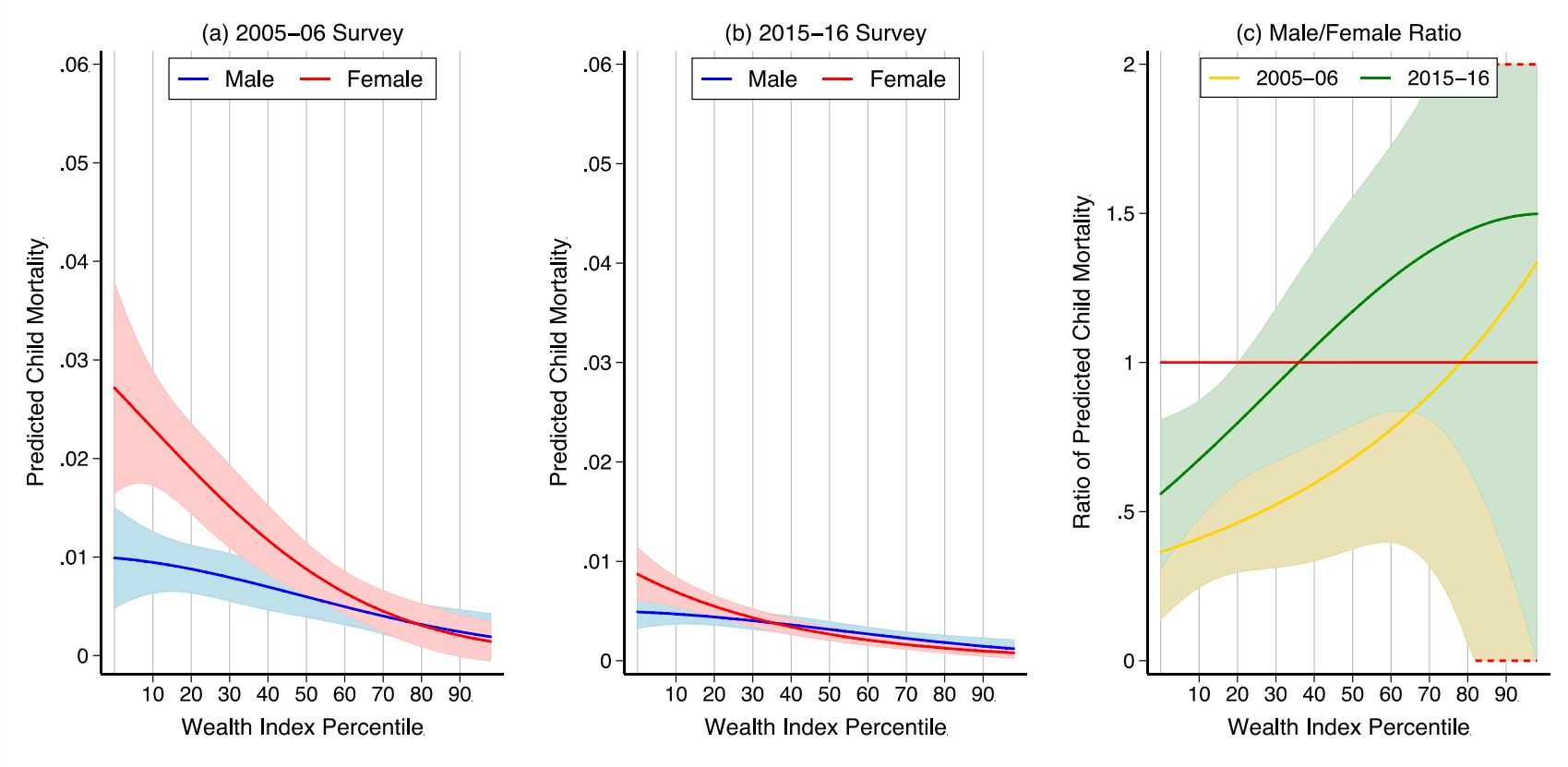
Figure 2. Predicted postneonatal mortality by sex and survey

,



Notes: Predicted probabilities from EQ1. The ratio is for predicted outcomes between males and females (the blue line divided by the red line). A ratio of one indicates equal predicted mortality. Ratio above one means proportionally greater mortality for males. A ratio below one means a proportionally greater mortality for females. Ratios under 0 and above 2 are omitted from the graph. Estimates are weighted and confidence intervals adjusted for clustering at the PSU level. See Table S2 for average predicted probabilities and Table S3 for average marginal effects of WIP, by sex and survey.

Figure 3. Predicted child mortality by sex and survey



Notes: Predicted probabilities from EQ1. The ratio is for predicted outcomes between males and females (the blue line divided by the red line). A ratio of one indicates equal predicted mortality. Ratio above one means proportionally greater mortality for males. A ratio below one means a proportionally greater mortality for females. Ratios under 0 and above 2 are omitted from the graph. Estimates are weighted and confidence intervals adjusted for clustering at the PSU level. See Table S2 for average predicted probabilities and Table S3 for average marginal effects of WIP, by sex and survey.

Socioeconomic and gender inequalities in neonatal, postneonatal, and child mortality in India: A repeated cross-sectional study, 2005-2016

Supplementary appendix

Table S1. Items used to construct the wealth index for India

Item in wealth index	% yes 2005-06	2015-16
Mattress	66·1	68·2
Pressure cooker	52·0	57·7
Chair	64·1	74·5
Cot or bed	84·2	89·5
Table	55·9	56·9
Electric fan	59·8	70·1
Radio or transistor	35·6	9·4
Black and white television	21·5	3·4
Colour television	35·6	60·5
Sewing machine	24·7	25·6
Mobile telephone	24·0	89·6
Telephone (non-mobile)	19·1	3·0
Internet	x	11·8
Computer	5·1	8·2
Refrigerator	22·9	27·8
Air conditioner/cooler	x	17·7
Washing machine	x	13·8
Watch or clock	82·7	76·8
Bicycle	44·9	48·7
Motorcycle or Scooter	20·7	34·6
Animal-drawn cart	3·9	3·6
Car	4·9	6·7
Water pump	10·0	15·2
Thresher	1·1	1·3
Tractor	1·4	2·7
Electricity	78·7	88·1
Owns this house only	83·3	x
Owns other houses only	15·5	x
Owns both this house and other	0·2	x
Does not own a house	1·0	x
Owns a house	x	82·9
Owns land	x	49·3
If household works own or family's agric· land	10·8	x
Rents house	1·3	x
Rent part of employment agreement	0·1	x
Rent other arrangement	0·1	x
Bank account	45·2	89·2
Domestic staff listed in HH	1·2	0·3
Number of members per sleeping room	3·0	2·7
House has any windows	74·0	x
House has windows with glass	25·6	x
House has windows with screens	21·5	x
House has windows with curtains or shutters	36·5	x
Source of drinking water:		
Piped - into dwelling	19·5	17·0
Piped - into yard / plot	14·0	13·2
Piped - public tap / standpipe	17·0	14·3
Tube well / borehole	29·6	38·3
Dug well - protected	3·1	3·4
Dug well - unprotected	8·3	5·5
Spring water - protected	1·7	1·0
Spring water - unprotected	2·2	1·2
Rainwater	0·2	0·3
Tanker truck	0·8	1·4
Cart with small tank	0·2	0·2
Surface water …	2·6	1·8
Bottled water	0·5	1·6
Community RO Plant	x	0·5
Other	0·4	0·2
Type of toilet facility:		
Flush - to piped sewer system	15·3	5·7
Flush - to septic tank	27·1	27·9
Flush - to pit latrine	7·1	8·7
Flush - to somewhere else	3·1	0·7
Flush - don't know where	x	0·1

Flush toilet, pit latrine	0·1	x
Ventilated Improved Pit …	0·3	0·6
Pit latrine - with slab	4·1	5·0
Pit latrine - without slab / open pit	3·5	2·3
Twin pit / composting toilet	0·1	0·2
Dry toilet	0·6	0·9
No facility / uses open space / or field	38·0	38·1
Flush - to piped sewer system - shared	x	0·8
Flush - to septic tank - shared	x	4·9
Flush - to pit latrine - shared	x	1·5
Flush - to somewhere else - shared	x	0·2
Flush - don't know where - shared	x	0·0
Ventilated Improved Pit … - shared	x	0·1
Pit latrine - with slab - shared	x	1·1
Pit latrine - without slab / open pit - shared	x	0·5
Twin pit / composting toilet - shared	x	0·0
Dry toilet - shared	x	0·2
Other - shared	x	0·1
Other	0·5	0·1
Main material of floor:		
Mud / clay / earth	26·3	29·7
Sand	0·9	0·8
Dung	9·8	8·2
Raw wood planks	1·7	1·8
Palm / bamboo	0·9	1·4
Brick	0·8	0·7
Stone	4·4	3·9
Parquet / polished wood	0·8	0·5
Vinyl / asphalt	0·6	0·7
Ceramic tiles	5·7	6·8
Cement	38·5	38·5
Carpet	1·0	1·0
Polished stone / marble / granite	8·1	5·8
Other	0·5	0·1
Main wall material:		
No walls	0·1	0·5
Cane / palm / trunks / bamboo	4·9	3·8
Mud	16·4	15·2
Grass / reeds / thatch	1·0	0·9
Bamboo with mud	5·4	5·0
Stone with mud	2·6	2·7
Uncovered adobe wall	1·1	x
Plywood	0·1	0·2
Cardboard	0·0	0·1
Unburnt brick	0·0	2·1
Raw wood / reused wood	1·6	0·9
Cement / concrete	42·7	30·8
Stone with lime / cement	6·0	5·7
Burnt bricks	13·5	24·0
Cement blocks	3·1	5·4
Wood planks / shingles	0·5	0·5
GI/ metal / asbestos sheets	0·5	1·9
Other	0·5	0·3
Main roof material:		
No roof	0·1	0·2
Thatch / palm leaf / reed / grass	9·1	4·7
Mud	0·8	1·0
Sod / mud and grass mixture	0·9	0·9
Plastic / polythene sheeting	0·5	0·7
Rustic mat	0·1	0·1
Palm / bamboo	1·7	0·7
Unburnt brick	0·1	0·4
Raw wood planks / timber	1·1	0·7
Loosely packed stone	1·1	2·7
Metal / GI	18·2	18·9
Wood	0·8	1·4
Calamine / cement fiber	1·0	2·4
Asbesto sheets	5·7	5·7
RCC / RBC / cement / concrete	34·4	34·2
Roofing shingles	6·6	2·4

Tiles	12·6	6·0
Slate	3·5	8·2
Burnt brick	1·1	5·3
Other	0·6	3·3
Type of cooking fuel:		
Electricity	0·7	1·0
LPG / natural gas	35·4	36·2
Biogas	0·4	0·5
Kerosene	5·1	1·0
Coal / lignite	1·6	1·1
Charcoal	0·5	0·6
Wood	43·9	48·2
Straw / shrubs / grass	2·9	1·6
Agricultural crop waste	2·4	2·3
Dung cakes	6·7	7·1
Other	0·5	0·0
No food cooked in household	x	0·2
N	109,041	601,509

Notes: All values are percentages except those underlined, which are means. Source: (DHS, 2018)

Table S2. Average probability of mortality by sex and survey

	Male		Female		Sex difference	
	Prediction	95% CI	Prediction	95% CI	Prediction	95% CI
			Neonatal Mortality			
2005-06	0·040***	[0·037, 0·043]	0·036***	[0·033, 0·039]	0·004	[-0·001, 0·008]
2015-16	0·032***	[0·031, 0·034]	0·026***	[0·024, 0·027]	0·007***	[0·005, 0·008]
Change	0·007***	[0·004, 0·011]	0·010***	[0·007, 0·014]	-0·003	[-0·008, 0·002]
			Postneonatal Mortality			
2005-06	0·016***	[0·014, 0·018]	0·022***	[0·019, 0·025]	-0·006***	[-0·009, -0·003]
2015-16	0·012***	[0·011, 0·013]	0·014***	[0·013, 0·015]	-0·002***	[-0·003, -0·001]
Change	0·004***	[0·002, 0·007]	0·008***	[0·006, 0·011]	-0·004**	[-0·008, -0·001]
			Child Mortality			
2005-06	0·007***	[0·005, 0·008]	0·012***	[0·010, 0·015]	-0·006***	[-0·008, -0·003]
2015-16	0·003***	[0·003, 0·004]	0·004***	[0·003, 0·004]	0·000	[-0·001, 0·000]
Change	0·003***	[0·002, 0·005]	0·009***	[0·006, 0·011]	-0·005***	[-0·008, -0·003]

Notes: *$P < 0·10$; ** $p < 0·05$; *** $p < 0·01$. All estimates are weighted using probability weights for respondents and adjusted for clustering at the PSU level.

Table S3. Average marginal effects (AME) of mortality for a 10 percentile increase in wealth by sex and survey

	Male		Female		Sex difference	
	AME	95% CI	AME	95% CI	AME	95% CI
			Neonatal Mortality			
2005-06	-0·0023***	[-0·0036, -0·0009]	-0·0029***	[-0·0043, -0·0015]	0·0006	[-0·0013, 0·0026]
2015-16	-0·0035***	[-0·0041, -0·0029]	-0·0021***	[-0·0026, -0·0016]	-0·0014***	[-0·0022, -0·0006]
Difference	0·0013*	[-0·0002, 0·0028]	-0·0008	[-0·0023, 0·0007]	0·0021*	[-0·0001, 0·0042]
			Postneonatal Mortality			
2005-06	-0·0018***	[-0·0028, -0·0009]	-0·0017***	[-0·0027, -0·0007]	-0·0001	[-0·0015, 0·0012]
2015-16	-0·0014***	[-0·0018, -0·0011]	-0·0016***	[-0·0020, -0·0012]	0·0002	[-0·0003, 0·0007]
Difference	-0·0004	[-0·0014, 0·0006]	-0·0001	[-0·0012, 0·0010]	-0·0003	[-0·0018, 0·0011]
			Child Mortality			
2005-06	-0·0008**	[-0·0015, -0·0001]	-0·0028***	[-0·0042, -0·0015]	0·0020***	[0·0006, 0·0035]
2015-16	-0·0004***	[-0·0006, -0·0001]	-0·0009***	[-0·0012, -0·0006]	0·0005***	[0·0001, 0·0009]
Difference	-0·0004	[-0·0012, 0·0003]	-0·0020***	[-0·0034, -0·0006]	0·0015*	[-0·0000, 0·0031]

Notes: *$P < 0{\cdot}10$; ** $p < 0{\cdot}05$; *** $p < 0{\cdot}01$. All estimates are weighted using probability weights for respondents and adjusted for clustering at the PSU level. The wealth index percentiles are calculated using probability weights for households. Average marginal effects (AME) indicate the average increase in probability of mortality for a 10 percentile increase in household wealth.

Table S4. Average probability of mortality by sex and survey for sub regions

Central India

	Male		Female		Sex difference	
	Prediction	95% CI	Prediction	95% CI	Prediction	95% CI
			Neonatal Mortality			
2005-06	0·044***	[0·034 , 0·054]	0·045***	[0·033 , 0·057]	-0·001	[-0·017 , 0·014]
2015-16	0·041***	[0·038 , 0·045]	0·034***	[0·030 , 0·037]	0·008***	[0·003 , 0·013]
Change	0·002	[-0·008 , 0·013]	0·012*	[-0·001 , 0·024]	-0·009	[-0·026 , 0·007]
			Postneonatal Mortality			
2005-06	0·022***	[0·014 , 0·030]	0·024***	[0·016 , 0·032]	-0·002	[-0·013 , 0·009]
2015-16	0·015***	[0·012 , 0·017]	0·016***	[0·014 , 0·019]	-0·002	[-0·005 , 0·001]
Change	0·008*	[-0·000 , 0·016]	0·008*	[-0·001 , 0·016]	0	[-0·011 , 0·011]
			Child Mortality			
2005-06	0·014***	[0·007 , 0·021]	0·016***	[0·008 , 0·024]	-0·002	[-0·012 , 0·007]
2015-16	0·005***	[0·004 , 0·006]	0·005***	[0·004 , 0·006]	0	[-0·002 , 0·002]
Change	0·009**	[0·002 , 0·016]	0·011**	[0·003 , 0·019]	-0·002	[-0·012 , 0·007]

East India

	Male		Female		Sex difference	
	Prediction	95% CI	Prediction	95% CI	Prediction	95% CI
			Neonatal Mortality			
2005-06	0·046***	[0·038 , 0·054]	0·034***	[0·028 , 0·041]	0·011**	[0·001 , 0·022]
2015-16	0·035***	[0·032 , 0·038]	0·026***	[0·024 , 0·029]	0·009***	[0·005 , 0·012]
Change	0·010**	[0·002 , 0·019]	0·008**	[0·001 , 0·015]	0·002	[-0·009 , 0·013]
			Postneonatal Mortality			
2005-06	0·015***	[0·011 , 0·020]	0·023***	[0·017 , 0·029]	-0·008**	[-0·015 , -0·001]
2015-16	0·011***	[0·009 , 0·012]	0·012***	[0·011 , 0·014]	-0·001	[-0·004 , 0·001]
Change	0·005*	[-0·000 , 0·009]	0·011***	[0·005 , 0·017]	-0·006*	[-0·014 , 0·001]
			Child Mortality			
2005-06	0·006***	[0·003 , 0·009]	0·011***	[0·006 , 0·015]	-0·005*	[-0·010 , 0·001]
2015-16	0·003***	[0·002 , 0·004]	0·003***	[0·002 , 0·004]	0	[-0·001 , 0·001]
Change	0·003*	[-0·000 , 0·007]	0·008***	[0·003 , 0·012]	-0·005*	[-0·010 , 0·001]

North India

	Male		Female		Sex difference	
	Prediction	95% CI	Prediction	95% CI	Prediction	95% CI
			Neonatal Mortality			
2005-06	0·043***	[0·037 , 0·050]	0·039***	[0·033 , 0·045]	0·004	[-0·004 , 0·013]
2015-16	0·040***	[0·037 , 0·043]	0·035***	[0·033 , 0·038]	0·005***	[0·001 , 0·009]
Change	0·003	[-0·004 , 0·010]	0·004	[-0·002 , 0·011]	-0·001	[-0·010 , 0·008]
			Postneonatal Mortality			
2005-06	0·020***	[0·015 , 0·024]	0·029***	[0·024 , 0·035]	-0·010***	[-0·017 , -0·003]
2015-16	0·015***	[0·014 , 0·017]	0·021***	[0·019 , 0·023]	-0·006***	[-0·008 , -0·003]
Change	0·004*	[-0·000 , 0·009]	0·008***	[0·002 , 0·014]	-0·004	[-0·012 , 0·003]
			Child Mortality			
2005-06	0·006***	[0·003 , 0·009]	0·020***	[0·014 , 0·026]	-0·014***	[-0·020 , -0·008]
2015-16	0·004***	[0·003 , 0·005]	0·006***	[0·005 , 0·007]	-0·002***	[-0·004 , -0·000]
Change	0·002	[-0·001 , 0·005]	0·014***	[0·008 , 0·020]	-0·012***	[-0·019 , -0·006]

Northeast India

	Male		Female		Sex difference	
	Prediction	95% CI	Prediction	95% CI	Prediction	95% CI
			Neonatal Mortality			
2005-06	0·040***	[0·029 , 0·051]	0·035***	[0·023 , 0·046]	0·005	[-0·010 , 0·021]
2015-16	0·031***	[0·027 , 0·035]	0·023***	[0·019 , 0·028]	0·007**	[0·001 , 0·013]
Change	0·009	[-0·002 , 0·021]	0·011*	[-0·001 , 0·023]	-0·002	[-0·019 , 0·015]
			Postneonatal Mortality			
2005-06	0·025***	[0·015 , 0·036]	0·017***	[0·010 , 0·024]	0·008	[-0·004 , 0·021]
2015-16	0·016***	[0·013 , 0·019]	0·015***	[0·012 , 0·018]	0·001	[-0·003 , 0·005]
Change	0·010*	[-0·001 , 0·020]	0·002	[-0·006 , 0·010]	0·008	[-0·006 , 0·021]
			Child Mortality			
2005-06	0·014***	[0·007 , 0·021]	0·008***	[0·003 , 0·013]	0·006	[-0·001 , 0·014]
2015-16	0·003***	[0·002 , 0·004]	0·003***	[0·002 , 0·005]	0	[-0·002 , 0·002]
Change	0·011***	[0·004 , 0·018]	0·005*	[-0·001 , 0·010]	0·007	[-0·001 , 0·014]

South India

	Male		Female		Sex difference	

	Prediction	95% CI	Prediction	95% CI	Prediction	95% CI
			Neonatal Mortality			
2005-06	0·030***	[0·023 , 0·036]	0·027***	[0·020 , 0·035]	0·003	[-0·007 , 0·012]
2015-16	0·019***	[0·016 , 0·022]	0·014***	[0·012 , 0·017]	0·005***	[0·001 , 0·009]
Change	0·011***	[0·003 , 0·018]	0·013***	[0·005 , 0·021]	-0·003	[-0·013 , 0·007]
			Postneonatal Mortality			
2005-06	0·011***	[0·007 , 0·016]	0·012***	[0·007 , 0·017]	-0·001	[-0·007 , 0·006]
2015-16	0·008***	[0·006 , 0·010]	0·008***	[0·006 , 0·010]	-0·001	[-0·003 , 0·002]
Change	0·004	[-0·001 , 0·008]	0·004	[-0·002 , 0·009]	0	[-0·008 , 0·007]
			Child Mortality			
2005-06	0·004**	[0·001 , 0·006]	0·004***	[0·001 , 0·007]	-0·001	[-0·005 , 0·003]
2015-16	0·003***	[0·002 , 0·005]	0·002***	[0·001 , 0·004]	0·001	[-0·001 , 0·003]
Change	0	[-0·003 , 0·003]	0·002	[-0·001 , 0·006]	-0·002	[-0·007 , 0·003]

Western India

	Male		Female		Sex difference	
	Prediction	95% CI	Prediction	95% CI	Prediction	95% CI
			Neonatal Mortality			
2005-06	0·034***	[0·027 , 0·041]	0·037***	[0·029 , 0·044]	-0·003	[-0·013 , 0·007]
2015-16	0·026***	[0·022 , 0·029]	0·019***	[0·016 , 0·022]	0·007***	[0·002 , 0·011]
Change	0·008**	[0·000 , 0·016]	0·017***	[0·010 , 0·025]	-0·010*	[-0·021 , 0·002]
			Postneonatal Mortality			
2005-06	0·012***	[0·008 , 0·016]	0·018***	[0·013 , 0·024]	-0·006*	[-0·013 , 0·000]
2015-16	0·011***	[0·008 , 0·013]	0·009***	[0·007 , 0·012]	0·001	[-0·002 , 0·005]
Change	0·001	[-0·003 , 0·006]	0·009***	[0·003 , 0·015]	-0·007**	[-0·015 , -0·000]
			Child Mortality			
2005-06	0·006***	[0·003 , 0·010]	0·010***	[0·006 , 0·015]	-0·004	[-0·009 , 0·002]
2015-16	0·002***	[0·002 , 0·003]	0·003***	[0·002 , 0·004]	-0·001	[-0·002 , 0·001]
Change	0·004**	[0·001 , 0·007]	0·007***	[0·002 , 0·012]	-0·003	[-0·009 , 0·002]

Notes: *$P < 0{\cdot}10$; ** $p < 0{\cdot}05$; *** $p < 0{\cdot}01$. All estimates are weighted using probability weights for respondents and adjusted for clustering at the PSU level.

Table S5. Average marginal effects (AME) on mortality for a 10 percentile increase in wealth by sex and survey for sub regions

Central India

	Male		Female		Sex difference	
	Prediction	95% CI	Prediction	95% CI	Prediction	95% CI
			Neonatal Mortality			
2005-06	-0·0016	[-0·0050, 0·0018]	-0·0009	[-0·0042, 0·0024]	-0·0007	[-0·0051, 0·0037]
2015-16	-0·0028***	[-0·0041, -0·0015]	-0·0020***	[-0·0034, -0·0006]	-0·0008	[-0·0027, 0·0010]
Change	0·0012	[-0·0024, 0·0049]	0·0011	[-0·0025, 0·0047]	0·0001	[-0·0047, 0·0049]
			Postneonatal Mortality			
2005-06	-0·0016	[-0·0045, 0·0013]	-0·0042**	[-0·0077, -0·0008]	0·0027	[-0·0021, 0·0075]
2015-16	-0·0019***	[-0·0029, -0·0009]	-0·0025***	[-0·0034, -0·0015]	0·0006	[-0·0007, 0·0019]
Change	0·0003	[-0·0027, 0·0034]	-0·0018	[-0·0053, 0·0018]	0·0021	[-0·0029, 0·0070]
			Child Mortality			
2005-06	-0·0023	[-0·0054, 0·0008]	-0·0017	[-0·0040, 0·0006]	-0·0006	[-0·0044, 0·0032]
2015-16	-0·0009**	[-0·0018, -0·0001]	-0·0010***	[-0·0016, -0·0004]	0·0001	[-0·0009, 0·0011]
Change	-0·0014	[-0·0046, 0·0019]	-0·0007	[-0·0031, 0·0016]	-0·0006	[-0·0046, 0·0033]

East India

	Male		Female		Sex difference	
	Prediction	95% CI	Prediction	95% CI	Prediction	95% CI
			Neonatal Mortality			
2005-06	-0·0014	[-0·0050, 0·0022]	-0·0015	[-0·0040, 0·0010]	0·0001	[-0·0043, 0·0046]
2015-16	-0·0035***	[-0·0048, -0·0022]	-0·0022***	[-0·0034, -0·0011]	-0·0013	[-0·0029, 0·0004]
Change	0·0021	[-0·0017, 0·0059]	0·0007	[-0·0021, 0·0035]	0·0014	[-0·0033, 0·0061]
			Postneonatal Mortality			
2005-06	-0·0013	[-0·0033, 0·0007]	-0·0013	[-0·0034, 0·0007]	0	[-0·0026, 0·0026]
2015-16	-0·0009***	[-0·0015, -0·0003]	-0·0009**	[-0·0016, -0·0001]	-0·0001	[-0·0010, 0·0009]
Change	-0·0004	[-0·0025, 0·0017]	-0·0005	[-0·0027, 0·0017]	0·0001	[-0·0027, 0·0028]
			Child Mortality			
2005-06	0·0004	[-0·0010, 0·0018]	-0·0029*	[-0·0061, 0·0002]	0·0033*	[-0·0001, 0·0067]
2015-16	-0·0007**	[-0·0014, -0·0001]	-0·0003*	[-0·0007, 0·0000]	-0·0004	[-0·0011, 0·0003]
Change	0·0011	[-0·0004, 0·0026]	-0·0026	[-0·0058, 0·0006]	0·0037**	[0·0002, 0·0072]

North India

	Male		Female		Sex difference	
	Prediction	95% CI	Prediction	95% CI	Prediction	95% CI
			Neonatal Mortality			
2005-06	-0·0034**	[-0·0062, -0·0006]	-0·0044***	[-0·0074, -0·0015]	0·001	[-0·0030, 0·0051]
2015-16	-0·0043***	[-0·0055, -0·0032]	-0·0024***	[-0·0035, -0·0013]	-0·0020**	[-0·0035, -0·0004]
Change	0·001	[-0·0021, 0·0040]	-0·002	[-0·0052, 0·0011]	0·003	[-0·0013, 0·0073]
			Postneonatal Mortality			
2005-06	-0·0019*	[-0·0039, 0·0001]	-0·0016	[-0·0037, 0·0004]	-0·0003	[-0·0031, 0·0025]
2015-16	-0·0016***	[-0·0023, -0·0008]	-0·0026***	[-0·0036, -0·0016]	0·0010*	[-0·0002, 0·0022]
Change	-0·0003	[-0·0024, 0·0017]	0·001	[-0·0013, 0·0032]	-0·0013	[-0·0044, 0·0017]
			Child Mortality			
2005-06	-0·0004	[-0·0015, 0·0007]	-0·0041**	[-0·0072, -0·0009]	0·0036**	[0·0003, 0·0070]
2015-16	-0·0005**	[-0·0009, -0·0001]	-0·0017***	[-0·0027, -0·0007]	0·0012**	[0·0002, 0·0023]
Change	0	[-0·0011, 0·0012]	-0·0023	[-0·0057, 0·0010]	0·0024	[-0·0011, 0·0059]

Northeast India

	Male		Female		Sex difference	
	Prediction	95% CI	Prediction	95% CI	Prediction	95% CI
			Neonatal Mortality			
2005-06	-0·0025	[-0·0076, 0·0025]	-0·0039	[-0·0103, 0·0024]	0·0014	[-0·0061, 0·0089]
2015-16	-0·0016**	[-0·0031, -0·0000]	-0·0019***	[-0·0033, -0·0006]	0·0003	[-0·0017, 0·0024]
Change	-0·001	[-0·0062, 0·0043]	-0·002	[-0·0085, 0·0045]	0·0011	[-0·0067, 0·0089]
			Postneonatal Mortality			
2005-06	-0·0024	[-0·0059, 0·0011]	0·0001	[-0·0017, 0·0020]	-0·0025	[-0·0063, 0·0012]
2015-16	-0·0020***	[-0·0033, -0·0006]	-0·0026***	[-0·0041, -0·0012]	0·0007	[-0·0012, 0·0026]
Change	-0·0005	[-0·0042, 0·0033]	0·0028**	[0·0004, 0·0052]	-0·0032	[-0·0075, 0·0010]
			Child Mortality			
2005-06	-0·0004	[-0·0023, 0·0015]	-0·0013	[-0·0035, 0·0009]	0·0009	[-0·0023, 0·0042]
2015-16	-0·0003*	[-0·0006, 0·0001]	-0·0006	[-0·0013, 0·0002]	0·0003	[-0·0005, 0·0011]
Change	-0·0001	[-0·0020, 0·0018]	-0·0007	[-0·0031, 0·0016]	0·0006	[-0·0027, 0·0040]

South India

	Male		Female		Sex difference	
	Prediction	95% CI	Prediction	95% CI	Prediction	95% CI
			Neonatal Mortality			
2005-06	0·0004	[-0·0019, 0·0027]	-0·0006	[-0·0035, 0·0023]	0·001	[-0·0026, 0·0045]
2015-16	-0·0029***	[-0·0042, -0·0015]	-0·0015***	[-0·0024, -0·0006]	-0·0014	[-0·0030, 0·0003]
Change	0·0032**	[0·0005, 0·0059]	0·0009	[-0·0021, 0·0039]	0·0023	[-0·0016, 0·0062]
			Postneonatal Mortality			
2005-06	-0·0021*	[-0·0046, 0·0004]	-0·0018	[-0·0043, 0·0006]	-0·0003	[-0·0038, 0·0032]
2015-16	-0·0011**	[-0·0019, -0·0003]	-0·0010***	[-0·0018, -0·0003]	0	[-0·0012, 0·0011]
Change	-0·001	[-0·0037, 0·0016]	-0·0008	[-0·0034, 0·0018]	-0·0002	[-0·0039, 0·0035]
			Child Mortality			
2005-06	-0·0022	[-0·0049, 0·0006]	0·0001	[-0·0005, 0·0007]	-0·0023	[-0·0051, 0·0005]
2015-16	-0·0003	[-0·0009, 0·0003]	-0·0009**	[-0·0017, -0·0001]	0·0006	[-0·0004, 0·0016]
Change	-0·0019	[-0·0047, 0·0009]	0·0010*	[-0·0000, 0·0020]	-0·0029*	[-0·0059, 0·0001]

Western India

	Male		Female		Sex difference	
	Prediction	95% CI	Prediction	95% CI	Prediction	95% CI
			Neonatal Mortality			
2005-06	-0·0022*	[-0·0047, 0·0003]	-0·0048**	[-0·0086, -0·0009]	0·0025	[-0·0019, 0·0070]
2015-16	-0·0017**	[-0·0032, -0·0001]	-0·0007	[-0·0016, 0·0003]	-0·001	[-0·0028, 0·0007]
Change	-0·0005	[-0·0034, 0·0024]	-0·0041**	[-0·0081, -0·0001]	0·0036	[-0·0012, 0·0083]
			Postneonatal Mortality			
2005-06	-0·0022**	[-0·0042, -0·0001]	-0·0004	[-0·0023, 0·0014]	-0·0017	[-0·0046, 0·0011]
2015-16	-0·0019***	[-0·0028, -0·0009]	-0·0016***	[-0·0026, -0·0006]	-0·0003	[-0·0017, 0·0011]
Change	-0·0003	[-0·0026, 0·0020]	0·0012	[-0·0009, 0·0033]	-0·0014	[-0·0046, 0·0017]
			Child Mortality			
2005-06	-0·0008	[-0·0022, 0·0006]	-0·0042**	[-0·0076, -0·0009]	0·0034*	[-0·0002, 0·0070]
2015-16	-0·0002	[-0·0006, 0·0002]	-0·0008*	[-0·0017, 0·0001]	0·0006	[-0·0004, 0·0016]
Change	-0·0006	[-0·0021, 0·0008]	-0·0034*	[-0·0069, 0·0000]	0·0028	[-0·0009, 0·0066]

Notes: *$P < 0·10$; ** $p < 0·05$; *** $p < 0·01$. All estimates are weighted using probability weights for respondents and adjusted for clustering at the PSU level. The wealth index percentiles are calculated using probability weights for households, separately for each sub region. Average marginal effects (AME) indicate the average increase in probability of mortality for a 10 percentile increase in household wealth.